COMPENSATION OF ALTIMETERS AND ALTIGRAPHS FOR AIR TEMPERATURE

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The altitudes of aircraft are usually determined by an altimeter, which is an aneroid barometer calibrated to an altitude-pressure relation containing an arbitrary altitude-temperature assumption. If the correction due to the variation of the temperature from that of the altitude-temperature assumption is required, additional observations are needed, namely, free-air temperatures from the ground level to the altitude. For the accuracy required in aeronautics, altitudes should be determined by both pressure and temperature measurements. It is difficult to take account of the mean temperature term of the barometric formula mechanically in an instrument. The following new relation based on the summer, winter, and yearly averages of observations of upper-air temperatures at latitude 40° in the United States is presented as a substitute. Up to 30,000 feet it is found that for a given altitude free-air pressures plotted against free-air temperatures give straight lines. This relation is based on standard sea-level pressure. Mathematically,

$$\frac{dP}{dT} = A_h \qquad (1)$$

where P is the pressure and T the absolute temperature at the altitude h, and A_h is a constant for any one altitude. In order to have a simple compensating mechanism, the amount of compensation in pressure units per degree change in air temperature per unit change in air pressure should be constant. This desirable relation may be stated in symbols,

$$\frac{dP}{(P_o - P)\,dT} = \frac{A_h}{P_o - P} = K \qquad (2)$$

where $P_o = 760$ millimeters of mercury and K is a constant.

The values found for A_h and K are given below.

Altitude	A_h Mm. Hg. per °C.	K Compensation in mm. Hg. per °C. per mm. Hg. change in pressure
Feet		
4,000	0.375	0.0036
8,000	.750	.0038
12,000	1.04	.0038
16,000	1.15	.0033
20,000	1.20	.0029
24,000	1.20	.0026
30,000	1.20	.0023

It will be seen that the value of K varies with altitude. The adoption of a value of 0.0029 for K gives rise to maximum deviations varying from 0 to 3.5 per cent of the altitude, while the compensation given by this value of K under the same conditions amounts to about 9 per cent.

In order to test this method of compensation further the values were compared with values of free air pressure determined by 15 observed altitude-temperatures curves which contained marked "temperature inversions." These curves were obtained from the aerological division of the United States Weather Bureau. The compensation given in the table compared with that required for these abnormal distributions of temperature was complete on the average within 10 to 20 per cent.

The multiplication of the mechanism of an altimeter or altigraph may be modified by the insertion of a temperature element or manually operated device so as to compensate according to the values of K given in the table, or more simply, to the average value of K. An instrument so compensated is said to be compensated for air temperature. If a manually operated device modifies the multiplication according to average values of K corresponding to free-air temperature and if the temperature dial is graduated in terms of ground level temperatures, the instrument is said to be compensated for ground temperature. The essential difference in the two types of compensation lies in the fact that in the first the compensation depends on free-air temperature, while in the second on air temperature at the ground level.

The Bureau of Standards has under construction an altigraph compensated for air temperature and an altimeter compensated for ground temperature.

NOTES, ABSTRACTS, AND REVIEWS

TRANSMISSION OF METEOROLOGICAL CHARTS BY RADIO IN EUROPE

The broadcasting station at Munich will henceforth transmit meteorological charts by radio every week-day morning about 9 a. m. and on Sundays and holidays at 12.15, using the Dieckmann telephotographic system.

According to the Manchester Guardian, the Munich distributing station receives for this purpose from the Central Meteorological Office of Bavaria a chart made with a special nonconducting ink and traced complete on a conducting sheet of metal.

The chart is rolled upon a drum turned by a clockwork mechanism, and on this drum rests a very fine transmitting stylus, which is moved along parallel with the axis of the drum. Thus the stylus describes upon the chart a spiral of very closely spaced lines.

According as the stylus is in contact with a conducting or a nonconducting part, a circuit is opened or closed and the currents are sent by wire to the Munich station, which in turn transmits them by radio. At the receiving stations a special chemical paper is used. Each transmission lasts about five minutes.—*La Nature, July 17, 1926. Translation B. M. V.*